

Climatic controls on the triple oxygen isotope composition of East African monsoon precipitation and implications for speleothem paleoclimate reconstructions

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Future evolution of the East African monsoon under increasing atmospheric CO₂ levels is highly uncertain. This is partly due to a limited understanding of past monsoon variability inferred from traditional water isotope-based proxy records that dominate available climate archives (e.g. speleothems) across the region. Despite significant progress in precipitation isotope monitoring in eastern Africa, the ¹⁸O/¹⁶O system hasn't been fully constrained. The newly developed triple oxygen isotope (¹⁷O/¹⁶O, ¹⁸O/¹⁶O) technique could provide additional information to distinguish different climatic factors and processes that influence isotopic fractionation in the water cycle and paleo-precipitation proxy records in speleothems. Understanding the spatial and temporal variability of precipitation isotopes, and their climatic controls, is critical to unlocking the potential of paleoclimate records from this region. We will present the first triple oxygen isotope data from daily-resolved precipitation samples collected from multiple stations across Northern, Central, and Southern Ethiopian highlands and investigate the sensitivity of $\delta^{18}\text{O}$ and $\delta^{17}\text{O}$ to changes in monsoon precipitation and their potential as regional paleoclimate proxies.

Our previous results from stations under the direct influence of the East African monsoon show that $\delta^{18}\text{O}$ variations are poorly correlated to precipitation amount but show some correspondence to increased storm activity and deep convection (Bedaso et al., 2020). Triple oxygen isotope data of East African precipitation would provide additional constraints on the influence of evaporation, moisture source and convective processes in the hydrologic cycle. Ultimately, comparison between daily time series of triple oxygen isotopes from multiple stations, which are located in different climate regimes and physiographic regions at varying distance from coastlines, will allow us to examine the role of mesoscale and microscale convective processes on ¹⁷O-excess signature of monsoon precipitation. These datasets serve as a baseline for understanding cave proxy formation as we undertake reconstruction of Holocene monsoon history from newly collected speleothems from the Northwestern Ethiopian highlands.

References

Bedaso, Z. K., et al., 2020. *Journal of Hydrology* 585, p.124364.